IE 410 – INTRODUCTION TO ROBOTICS

Lab-6 report

Controlling Turtlesim Node using Python code, implementing P controller and implementing PID controller.

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- **Creating Catkin package**

First go to the ‘src’ folder of catkin workspace that we have created.

```
$ cd catkin_ws/src
```

Now create a catkin package named linuxsquad_pkgforlab4 by using the command given below.

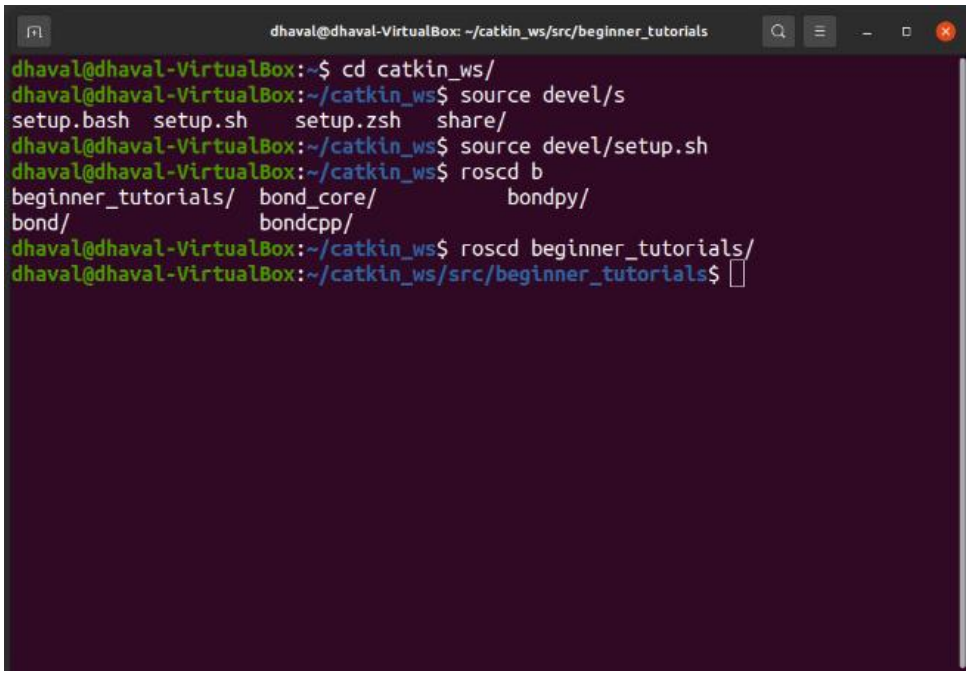
```
$ catkin_create_pkg beginner_tuts std_msgs rospy roscpp
```

Now we will execute catkin_make.

```
$ catkin_make
```

Now we need to source the generated setup file.

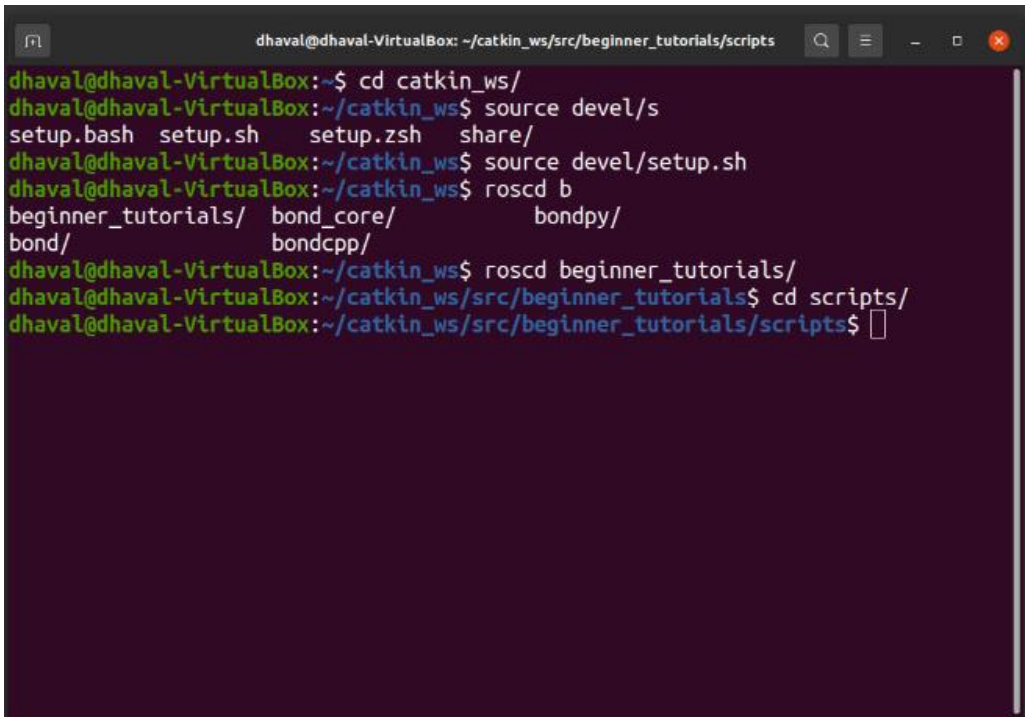
```
$ source devel/setup.bash
```



- **Turtlesim_move.py and Turtlesim_cleaner.py**

Now, we will change the directory to linuxsquad_pkglab6 and then will create a `scripts` directory in the linuxsquad_pkglab6 directory. Follow these commands.

```
$ roscd linuxsquad_pkgforlab6
$ mkdir scripts
$ cd scripts
```



- Turtlesim_cleaner.py

```
#!/usr/bin/env python

import rospy
from geometry_msgs.msg import Twist
from turtlesim.msg import Pose
import math
import time
from std_srvs.srv import Empty

x=0
y=0
yaw=0

def poseCallback(pose_message):
    global x
    global y, yaw
```

```
    x= pose_message.x
    y= pose_message.y
    yaw = pose_message.theta

    #print "pose callback"
    #print ('x = {}'.format(pose_message.x)) #new in python 3
    #print ('y = %f' %pose_message.y) #used in python 2
    #print ('yaw = {}'.format(pose_message.theta)) #new in python 3


def move(speed, distance, is_forward):
        #declare a Twist message to send velocity commands
        velocity_message = Twist()
        #get current location
        global x, y
        x0=x
        y0=y

        if (is_forward):
            velocity_message.linear.x =abs(speed)
        else:
               velocity_message.linear.x =-abs(speed)

        distance_moved = 0.0
        loop_rate = rospy.Rate(10) # we publish the velocity at 10 Hz (10
times a second)
        cmd_vel_topic='/turtle1/cmd_vel'
        velocity_publisher = rospy.Publisher(cmd_vel_topic, Twist,
queue_size=10)

        while True :
                rospy.loginfo("Turtlesim moves forwards")
                velocity_publisher.publish(velocity_message)

                loop_rate.sleep()

                #rospy.Duration(1.0)

                distance_moved = abs(0.5 * math.sqrt(((x-x0) ** 2) + ((y-
y0) ** 2)))
                print (distance_moved);
                if  not (distance_moved<distance):
                    rospy.loginfo("reached")
                    break

        #finally, stop the robot when the distance is moved
        velocity_message.linear.x =0
        velocity_publisher.publish(velocity_message)

def rotate (angular_speed_degree, relative_angle_degree, clockwise):

    global yaw
    velocity_message = Twist()
    velocity_message.linear.x=0
    velocity_message.linear.y=0
    velocity_message.linear.z=0
    velocity_message.angular.x=0
```

```
    velocity_message.angular.y=0
    velocity_message.angular.z=0

    #get current location
    theta0=yaw
    angular_speed=math.radians(abs(angular_speed_degree))

    if (clockwise):
        velocity_message.angular.z =-abs(angular_speed)
    else:
        velocity_message.angular.z =abs(angular_speed)

    angle_moved = 0.0
    loop_rate = rospy.Rate(10) # we publish the velocity at 10 Hz (10 times
a second)
    cmd_vel_topic='/turtle1/cmd_vel'
    velocity_publisher = rospy.Publisher(cmd_vel_topic, Twist,
queue_size=10)

    t0 = rospy.Time.now().to_sec()

    while True :
        rospy.loginfo("Turtlesim rotates")
        velocity_publisher.publish(velocity_message)

        t1 = rospy.Time.now().to_sec()
        current_angle_degree = (t1-t0)*angular_speed_degree
        loop_rate.sleep()



        if  (current_angle_degree>relative_angle_degree):
            rospy.loginfo("reached")
            break

    #finally, stop the robot when the distance is moved
    velocity_message.angular.z =0
    velocity_publisher.publish(velocity_message)


def go_to_goal(x_goal, y_goal):
    global x
    global y, yaw

    velocity_message = Twist()
    cmd_vel_topic='/turtle1/cmd_vel'

    while (True):
        K_linear = 0.5
        distance = abs(math.sqrt(((x_goal-x) ** 2) + ((y_goal-y) ** 2)))

        linear_speed = distance * K_linear


        K_angular = 4.0
        desired_angle_goal = math.atan2(y_goal-y, x_goal-x)
        angular_speed = (desired_angle_goal-yaw)*K_angular
```

```
        velocity_message.linear.x = linear_speed
        velocity_message.angular.z = angular_speed

        velocity_publisher.publish(velocity_message)

        #print velocity_message.linear.x
        #print velocity_message.angular.z
        print ('x=', x, 'y=',y)


        if (distance <0.01):
            break

def setDesiredOrientation(desired_angle_radians):
    relative_angle_radians = desired_angle_radians - yaw
    if relative_angle_radians < 0:
        clockwise = 1
    else:
        clockwise = 0
    print (relative_angle_radians)
    print( desired_angle_radians)
    rotate(30 ,math.degrees(abs(relative_angle_radians)), clockwise)

def gridClean():

    desired_pose = Pose()
    desired_pose.x = 1
    desired_pose.y = 1
    desired_pose.theta = 0

    moveGoal(desired_pose, 0.01)

    setDesiredOrientation(degrees2radians(desired_pose.theta))

    move(2.0, 9.0, True)
    rotate(degrees2radians(20), degrees2radians(90), False)
    move(2.0, 9.0, True)
    rotate(degrees2radians(20), degrees2radians(90), False)
    move(2.0, 1.0, True)
    rotate(degrees2radians(20), degrees2radians(90), False)
    move(2.0, 9.0, True)
    rotate(degrees2radians(30), degrees2radians(90), True)
    move(2.0, 1.0, True)
    rotate(degrees2radians(30), degrees2radians(90), True)
    move(2.0, 9.0, True)
    pass


def spiralClean():
    vel_msg = Twist()
    loop_rate = rospy.Rate(1)
    wk = 4
    rk = 0

    while((currentTurtlesimPose.x<10.5) and (currentTurtlesimPose.y<10.5)):
        rk=rk+1
```

```
        vel_msg.linear.x =rk
        vel_msg.linear.y =0
        vel_msg.linear.z =0
        vel_msg.angular.x = 0
        vel_msg.angular.y = 0
        vel_msg.angular.z =wk
        velocity_publisher.publish(vel_msg)
        loop_rate.sleep()

    vel_msg.linear.x = 0
    vel_msg.angular.z = 0
    velocity_publisher.publish(vel_msg)



if __name__ == '__main__':
    try:

        rospy.init_node('turtlesim_motion_pose', anonymous=True)

        #declare velocity publisher
        cmd_vel_topic='/turtle1/cmd_vel'
        velocity_publisher = rospy.Publisher(cmd_vel_topic, Twist,
queue_size=10)

        position_topic = "/turtle1/pose"
        pose_subscriber = rospy.Subscriber(position_topic, Pose,
poseCallback)
        time.sleep(2)

        #move(1.0, 2.0, False)
        #rotate(30, 90, True)
        go_to_goal(1.0, 1.0)
        #setDesiredOrientation(math.radians(90))

    except rospy.ROSInterruptException:
        rospy.loginfo("node terminated.")
```

- Turtlesim_move.py

```
#!/usr/bin/env python

import rospy
from geometry_msgs.msg import Twist
import math
import time
from std_srvs.srv import Empty



def move(speed, distance, is_forward):
        #declare a Twist message to send velocity commands
        velocity_message = Twist()
        #get current location
```

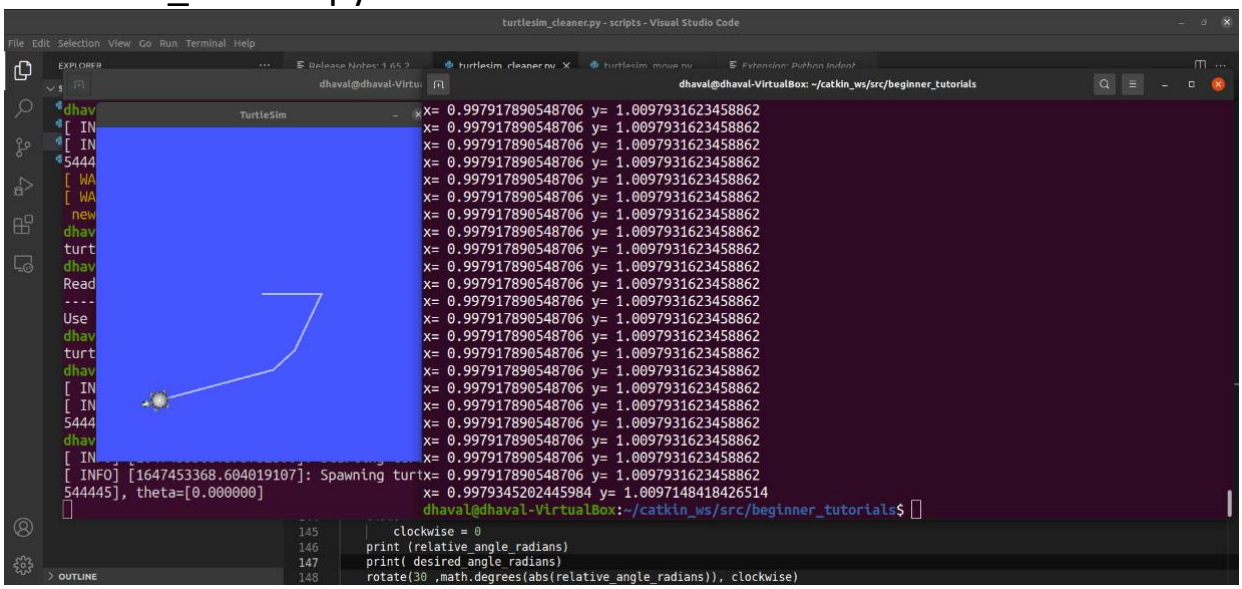
```
        if (speed > 0.4):
            print('speed must be lower than 0.4')
            return

        if (is_forward):
            velocity_message.linear.x =abs(speed)
        else:
               velocity_message.linear.x =-abs(speed)

        distance_moved = 0.0
        loop_rate = rospy.Rate(10) # we publish the velocity at 10 Hz (10
times a second)
        cmd_vel_topic='/cmd_vel_mux/input/teleop'
        velocity_publisher = rospy.Publisher(cmd_vel_topic, Twist,
queue_size=10)

        t0 = rospy.Time.now().to_sec()

        while True :
                rospy.loginfo("Turtlesim moves forwards")
                velocity_publisher.publish(velocity_message)

                loop_rate.sleep()
                t1 =  rospy.Time.now().to_sec()
                #rospy.Duration(1.0)

                distance_moved = (t1-t0) * speed
                print(distance_moved)
                if  not (distance_moved<distance):
                    rospy.loginfo("reached")
                    break

        #finally, stop the robot when the distance is moved
        velocity_message.linear.x =0
        velocity_publisher.publish(velocity_message)

def rotate (angular_speed_degree, relative_angle_degree, clockwise):


    velocity_message = Twist()
    velocity_message.linear.x=0
    velocity_message.linear.y=0
    velocity_message.linear.z=0
    velocity_message.angular.x=0
    velocity_message.angular.y=0
    velocity_message.angular.z=0

    angular_speed=math.radians(abs(angular_speed_degree))

    if (clockwise):
        velocity_message.angular.z =-abs(angular_speed)
    else:
        velocity_message.angular.z =abs(angular_speed)

    angle_moved = 0.0
```

```
    loop_rate = rospy.Rate(10) # we publish the velocity at 10 Hz (10 times
a second)
    cmd_vel_topic='/cmd_vel_mux/input/teleop'
    velocity_publisher = rospy.Publisher(cmd_vel_topic, Twist,
queue_size=10)

    t0 = rospy.Time.now().to_sec()

    while True :
        rospy.loginfo("Turtlesim rotates")
        velocity_publisher.publish(velocity_message)

        t1 = rospy.Time.now().to_sec()
        current_angle_degree = (t1-t0)*angular_speed_degree
        loop_rate.sleep()

        print('current_angle_degree: ',current_angle_degree)

        if  (current_angle_degree>relative_angle_degree):
            rospy.loginfo("reached")
            break

    #finally, stop the robot when the distance is moved
    velocity_message.angular.z =0
    velocity_publisher.publish(velocity_message)


def go_to_goal(x_goal, y_goal):
    global x
    global y, z, yaw

    velocity_message = Twist()
    cmd_vel_topic='/turtle1/cmd_vel'

    while (True):
        K_linear = 0.5
        distance = abs(math.sqrt(((x_goal-x) ** 2) + ((y_goal-y) ** 2)))

        linear_speed = distance * K_linear

        K_angular = 4.0
        desired_angle_goal = math.atan2(y_goal-y, x_goal-x)
        angular_speed = (desired_angle_goal-yaw)*K_angular

        velocity_message.linear.x = linear_speed
        velocity_message.angular.z = angular_speed

        velocity_publisher.publish(velocity_message)
        print('x=', x, 'y=',y)


        if (distance <0.01):
            break



if __name__ == '__main__':
```

```
try:

    rospy.init_node('turtlesim_motion_pose', anonymous=True)

    #move (0.3, 0.5 , False)
    time.sleep(1.0)
    rotate (90, 90 , True)

except rospy.ROSInterruptException:
    rospy.loginfo("node terminated.")
```

- Testing

Turtlesim_cleaner.py



Turtlesim_move.py